भारतीय मानक

रसायन प्रयोगशाला — सुरक्षा संहिता

(दूसरा पुनरीक्षण)

Indian Standard

CHEMICAL LABORATORIES — CODE OF SAFETY

(Second Revision)

ICS 13.100;13.300;71.040.10

BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

January 2013 **Price Group 8**

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Occupational Safety and Health and Chemical Hazards Sectional Committee had been approved by the Chemical Division Council.

The need for a code of safety for chemical laboratories stems from two factors, first due to hazards inherent in the nature and handling of chemicals, and second due to hazards from inadequacy or handling of instrumental facilities necessary in chemical laboratories, such as electricity, glassware, machinery equipment, gas, steam, water, apparatus for high/low temperature and pressure. Innumerable chemicals used as reagents and solvents are flammable/toxic/corrosive/poisonous, etc, and are harmful/irritants to body tissues.

The standard was originally published in 1966 and subsequently revised in 1987 to incorporate the general rules of conduct concerning safety, reference for handling highly toxic materials, emergency alarm system, etc, in laboratory designing, safety details for fire, emergency and rescue procedures; evacuation of site reporting systems under organization of laboratory and general laboratory techniques and fires under specific techniques. The Committee decided to revise this standard in view of incorporating the latest safety practices in the standard. In this revision general guidelines on safe disposal, incompatible materials, safe procedures to deal with spillage, electrical installations, and handling of chemicals at very low temperature are incorporated. Moreover format for material safety data sheet and list of chemicals and their incompatible materials are given in Annexes A and B.

This standard is one of a series of Indian Standards on safety in laboratories. The other standards in this series are IS 4906 : 1968 'Code of safety for radiochemical laboratory' and IS 12035 : 1986 'Code of safety in microbiological laboratories'.

The composition of the Committee responsible for formulating this standard is given in Annex C.

Indian Standard

CHEMICAL LABORATORIES — CODE OF SAFETY

(Second Revision)

1 SCOPE

1.1 This standard recommends a Code of safety for chemical laboratories.

1.1.1 This standard does not cover hazards relating to radioactive substances.

2 REFERENCES

The standards listed below contain provisions which through reference in this text constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standard indicated below:

IS No.	*Title*
2148 : 2004/ IEC 60079-1 : 2001	Electrical apparatus for explosive gas atmospheres — Flameproof enclosures 'd'
2190 : 1992	Selection, installation and maintenance of first-aid fire extinguishers — Code of practice (*second revision*)
2206 (Part 1) : 1984	Flameproof electric lighting fittings: Part 1 Well-glass and bulkhead types (*first revision*)
2379 : 1990	Colour code for identification of pipe lines (*first revision*)

3 FACTORS INVOLVING SAFETY

3.1 General

3.1.1 The rules of safety embodied in this standard should be ingrained in every employee so that their practice becomes a matter of day-to-day habit.

3.1.2 It will be the responsibility of the institution/ organization to force safety rules. Senior members are required to be vigilant to ensure that adequate infrastructural facilities are available for safe working and adequate information and guidance is available to junior members concerning a variety of chemical work being performed in laboratories. It will also be the responsibility of workers to adhere to safety rules and point out to senior members any unsafe condition/spots prevailing in and around the laboratory.

3.1.3 Every effort should be made to recognize areas of potential hazards and corrective action should be taken expeditiously to minimize accidents.

3.1.4 A complete record of accidents should be maintained by the institution to identify causative factors and to provide valuable guidance for the future.

3.2 Rules of Conduct

3.2.1 Smoking is strictly prohibited in working areas other than those specified.

3.2.2 Reporting to work in an intoxicated condition is strictly forbidden and punishable.

3.2.3 All other activities detrimental in maintaining safety in the laboratory should be strictly prohibited.

3.2.4 Work in isolation shall be avoided in a laboratory; always a second person should be within call.

3.2.5 Handling or consuming food or drinks in laboratories shall be avoided.

3.2.6 Good personal hygiene such as washing the hands thoroughly before handling or consuming food or drinks, having a thorough body wash or bath at the end of shift wherever insisted are essential.

3.2.7 Good housekeeping is considered as the backbone of laboratory safety. Returning equipment not in use to their proper storage place, clear labelling of chemicals, keeping laboratory floor free of obstruction and other good house-keeping practices should be strictly followed.

3.2.8 A periodic check of windows, store wells, fire appliances, first-aid boxes, etc, in the laboratory should be made.

3.2.9 A suitable fire extinguisher should be located close to each laboratory.

3.2.10 All substances should be regarded as potential sources of hazards and handled with care.

3.2.11 Safety carriers should be used for transporting glass or plastic containers with a capacity of two liters or greater. Incompatible chemicals should never be transported together. They should be transported in separate carriers.

3.2.12 All safety equipment shall be properly labelled and maintained in good operating condition and be regularly checked and inspected for correct operation in accordance with the manufacturer's instructions and record of such checks/inspections should be maintained.

3.2.13 Allowable maximum quantities of dangerous substances, consistent with efficient operation shall be established for each laboratory and never exceeded.

3.2.14 Safety information and emergency procedures should be prominently displayed. Emergency procedures should be posted in each laboratory giving telephone numbers of,

a) Fire brigade;

b) Ambulance;

c) Supervisor/Safety coordinator; and

d) Hospital.

3.2.15 Spills should be cleaned immediately and thoroughly. The nature of spills should be ascertained and spills treated accordingly.

3.2.16 In case of an injury, the supervisor and safety coordinator should be informed and prompt first-aid should be taken/provided.

3.2.17 All accidents should be reported to the immediate supervisor. All accidents should be investigated and recorded.

3.2.18 Standard operating procedure (SOP) should be available.

3.2.19 All unsafe conditions and unsafe acts by fellow workers, which are likely to cause an accident, should be reported, to the supervisor.

3.2.20 In case of an emergency such as a fire, explosion, etc, the supervisor should be informed or arrangement is to be made to inform the supervisor or safety coordinator or head of the department nearest available and laid down procedure is to be followed.

3.2.21 All the exits are to be kept free of obstructions to facilitate quick escape in an emergency.

3.2.22 Proper lift (meant for carrying materials) is to be used while carrying dry ice or liquid nitrogen. Liquid oxygen should not be used as a substitute for liquid nitrogen.

3.2.23 Separate cans should be kept to deposit broken glass as otherwise the person cleaning the laboratory can sustain cuts from glass, if mixed with other wastes like paper, rubber, etc.

3.2.24 Chemical wastes should be segregated category-wise and properly disposed off as per approved written procedures. Each laboratory should have a comprehensive safety manual.

3.2.25 Gas cylinders should never be dragged while transporting; when kept vertical, they should be chained to avoid their fall. While storage the valve cap should be in place. Pressure regulators specific to the gas only should be used.

3.2.26 In case of fire, lift should not be used.

4 LABORATORY DESIGN FOR SAFETY

4.1 Functional Design

4.1.1 *General*

Only those aspects of laboratory design which are relevant to make them safe places of work and are pertinent to accident hazards have been discussed in this standard. A laboratory is not a haphazard collection of rooms; but a well planned and designed building, where each room has a definite function and whose arrangement relative to the others also serves a definite objective. Thus in the design of each room as also of the whole laboratory there has to be a proper appreciation of the purpose. It is important that, in the planning of the laboratory, there should be consultation and collaboration between the architect and the engineer on the one hand, and the senior workers in the laboratory on the other. Even in old laboratories quite a lot may be achieved by minor alterations and adjustments to make them safe places for work.

4.1.2 *Laboratory Rooms*

4.1.2.1 The design of the laboratory will depend upon the specific needs of a particular laboratory. Thus, student laboratories should normally consist of large rooms, where a number of students can work, while a research or specialized analytical laboratory should consist of separate small units. From safety point of view the bay layout is preferable to separate suite of rooms because, in case of an accident, there is a greater chance of some other worker being in sight. Moreover, every laboratory should be provided with a few minimum necessities to ensure safety in working. Each laboratory room shall have two easily accessible exits (a fire escape, if a second door cannot be provided). If a bay layout is provided for each semi-enclosed cubicle, there should be an escape arrangement from the side away from the workbenches. The arrangement of immovable fittings should be such as to provide adequate moving space between benches. There should be no fittings on the floor, which would hinder or obstruct free movement. The design and arrangement of benches will naturally vary according to the function of each laboratory but adherence to certain minimum

requirements would go a long way to reduce accidents. Benches should not be too deep (widely accepted width is 75 cm) and the service line controls should be placed at the front below the bench top. The reagent shelves should be easily accessible and should not be unduly high. The reagent shelves should be provided with beading (and with centre partitions in the case of double-side shelves) to prevent bottles falling off due to vibrations. Wherever necessary, flame-proof electrical fittings conforming to IS 2206 (Part 1) should be provided in the laboratory. This should be the feature especially where large amount of solvents are handled. Laboratories should also be provided with adequate ventilation and efficient exhaust to prevent the build-up of the concentration of toxic vapours in the atmosphere.

4.1.2.2 *Ante-rooms*

A chemical laboratory should have, besides the actual laboratory rooms, separate rooms for: (a) doing pressure reactions and other hazardous operation; (b) overnight reactions; and (c) work involving large quantities of solvents. These rooms should preferably be located at the end of the main laboratories. The furniture used in the rooms should be made of fire resistant material and the room should be provided with exhaust fans. There should be a separate room (preferably air-conditioned) for handling other specialized analytical instruments like chromatograph, spectrometer, etc.

4.1.3 *Fume Cupboards/Fumehoods*

4.1.3.1 Each laboratory should be provided with efficient fume cupboards, sufficiently large to permit complete enclosure of apparatus normally used, and provided with a sink for the washing of apparatus used for handling toxic materials. For laboratories where large numbers of digestions are to be carried out, a separate ante-room equipped with efficient fume cupboard may be provided. The cupboard should not be too deep so that the fittings inside are easily accessible while the controls of the service connections should be provided outside. The fume cupboard should have corrosion-proof fittings. It should be provided with a light, so placed that the whole cupboard is illuminated. The shutter pans should be made of shatterproof or reinforced glass. The front shutter may be provided with small windows so that apparatus can be manipulated through these without lifting the shutter. The cupboard should be so designed that there is strong upward draught even when the shutter is open and there is no chance of any fumes entering the laboratory. In rooms where work with extremely poisonous gases is done, it is advisable to have an air inlet at the bottom (balanced-draught cupboard) so arranged as to sweep everything to the exhaust. It is desirable to have at least one such cupboard in every chemical laboratory. For fume cupboard, the exhaust fan should be able to create a face velocity of 30 m/min at normal working height (say 0.3 m). Cupboards for highly toxic materials require higher face velocities (45 m/min).

4.1.3.2 Hot concentrated perchloric acid should be handled in separate fume cupboards where its vapour does not contact any organic matter. (Separate fume hoods should be designed for perchloric acid hoods, cleaning should be done twice a week and record of cleaning should be available. Material of construction of the fume cupboard and allied implements/fixtures should not contain any organic constituents.)

4.1.4 *Service Connections*

All pipe lines in the laboratory should be differently coloured as specified in IS 2379 and each room of the laboratory should be provided with main valves at an easily accessible and prominently visible places so that, in an emergency, all services to a room can be cut-off from one point. There should also be arrangements for cutting-off the service connections of the entire laboratory from one place. Sinks and drains should be made of chemically resistant materials and the drains should be properly trapped and vented. The sinks should, wherever feasible, be flushed with liberal quantity of water after the contents from reactions vessels are discharged into them. Water immiscible solvents must not be poured in drains. Draining boards should be made of, or at least covered, with non-absorbent material. Drain boards made of wood absorb chemicals easily and tend to give vapours for a long period, hence wood as drain board, is not recommended.

4.1.5 *Laboratory Furnishings*

Furnishing (curtains, etc) which will easily catch fire should be avoided. Fire resistance properties of materials used for these should be carefully checked.

4.1.6 *Stores*

Where large quantities of explosive materials (but not explosives), inflammable substances, solvents or gas cylinders are to be stored, reference should be made to rules and regulations in force. The store should be provided with separate ante-rooms for keeping: (a) explosive materials; (b) inflammable substances; (c) poisonous substances; (d) solvents in bulk; (e) gas cylinders; and (f) acids. Care must be taken that incompatible materials are stored separately. Stores storing flammable solvents and chemicals should have flameproof equipment including switches conforming to IS 2148. Both the

main stores and its ante-rooms should be well lighted and well ventilated with proper exhausts to prevent build-up of the concentration of toxic agents. The ante-rooms should preferably be small separate blocks; however, if they have to be part of main stores building, their exit and entrance should be towards the outside of the main store rooms, and these rooms should be well protected from heat and direct sunlight. The electric light fittings should conform to IS 2206 (Part 1). Smoking shall not be permitted in the stores. Utmost care should be taken in the issue of bulk items. These should never be directly poured from carboys or drums but always be siphoned out. Explosive materials like sodamide, picric acid, etc, should be handled gently and carefully. Suitable equipment and materials should be kept handy to deal with any spillage problems.

4.2 Incompatible Material

While storing chemicals, it is necessary to know the incompatibles — those that react exothermally with one another. For example, fuels and reducing agents are incompatible with oxidizing agents. No two incompatibles should be stored together. Annex A gives an elaborate list of incompatible chemicals. Some of these incompatible chemicals are:

a) *Acid Chemicals* versus *Basic Chemicals* — Free acids like HCl, H_2SO_4, CH_3COOH or chemicals like potassium bisulphate should not be stored with bases like ammonia, lime, soda, metal oxides, etc.

b) *Ammonium Salts* versus *Basic Oxides or Carbonates* — These will react, may be with tragic end like fire or explosion; hence should not be stored together.

c) *Bleaching Powder* versus *Turpentine* — Bleaching powder liberates chlorine, which reacts exothermally with ammonia, ammonium carbonate or unsaturated organic substances like turpentine or linseed oil. This may be a source of fire. Hence adequate care should be taken while storing such chemicals.

4.3 Disposal

Safe disposal of chemicals is a specialized field. In many cases the method of disposal is substance-specific. The chemical properties, hazards, incompatibles, etc, should be studied and expert-advice should be sought. Planning for safe disposal has to be meticulous and the procedure should be approved by the competent authority. Execution should be under the guidance of experts. The following general guidelines could complement the safe disposal of chemicals:

a) Liquid and solid wastes should be kept separate.

b) Chemicals for disposal must be placed in a non-reactive, sealed container with a screw type cap. Waste container must be kept closed. Attach a tag to each and every container of the chemical waste. The outside of the containers must be clean and free of chemical contaminants and residues. Date and label each container. All chemical waste containers must be conspicuously labelled with the following information:

   1) Hazardous waste;
   2) Full name(s) of chemical contents and approximate percent if necessary [IUPAC and common names are acceptable, abbreviations or chemical formulas are not acceptable];
   3) Responsible person or supervisor; and
   4) Building, room number and contact phone number.

c) Separate wastes into the different waste categories that collect acids in a separate container from solvents, etc. Incompatible materials should not be mixed (*see* Annex A) in the same container. Corrosive or reactive chemicals should not be put in metal cans.

d) For liquids, fill containers to about 90 percent of container volume. Containers should not be filled to the brim.

e) Metal barrels should not be stored outside where they will rust. Smaller containers of chemicals should not be packed into a large drum for disposal.

f) Regarding some of the specific substances, the following must be noted while planning disposal.

   1) *Ignitable liquids and organic solvents* — Halogenated wastes should be separated from non-halogented solvent wastes. Separate organic solvents from aqueous solutions. Keep acidified solvents separate from other solvents and acid wastes.
   2) *Acids, bases, and aqueous solutions* — Strong inorganic acids or oxidizers with organic compounds should not be mixed . Keep acids, bases or aqueous solutions containing heavy metals separate from other wastes. Avoid mixing concentrated acids and bases together in the same container.
   3) Wastes containing mercury salts should be separated from all other wastes.

4) *Corrosive materials* — Corrosive liquids shall not be mixed with any other hazardous waste under any circumstances.

5) Perchloric acid and perchlorates — Keep perchloric acid and perchlorate wastes separate from other wastes.

6) *Toxic wastes* — Separate toxic wastes from other hazardous wastes.

7) *Paint and paint thinner* — Separate solid sludge from paint thinners by pouring off thinners into a separate waste container. Brushes, rollers, paper or other debris should not be put in paint wastes. Water and water-base paint wastes should be separated from oil-base paint wastes. Label wastes as paint stripper waste or paint sludge.

8) *Oils, lubricating fluids and cooling fluids* — Flammable solvents, halogenated solvents (degreasers), water or antifreeze should not be mixed with waste oils.

4.4 Safety Equipment

The following items should be available as protective equipment in all chemical laboratories. The main items are:

a) *Safety Glasses/Face Shields* — Eye protection at minimum level implies safety goggles.

b) *Aprons* — Various types of aprons are available like PVC, rubber or cotton to protect against specific hazards.

c) *Gloves* — Wear protective gloves to handle chemicals (rubber, PVC, etc). To handle sharp objects use gloves made out of leather, canvas, etc. Other items for specialized protection should be available and all personnel must be aware of their location and use. They are,

1) *Safety equipment*:

i) Fire blankets;
ii) Eye wash devices; and
iii) Safety showers.

2) *Personal protective equipment*:

i) Breathing apparatus;
ii) Positive pressure hoods;
iii) Helmets; and
iv) Gas masks.

All the personal protective equipment for common use should be kept in their proper places, and cleaned thoroughly after use. Defective equipment should be immediately replaced.

5 ORGANIZATION OF LABORATORY SAFETY

5.1 Separate committee should be available to review the laboratory chemical safety. The nature of the organization required for implementation of good laboratory practice in a chemical laboratory will depend on the size of the establishment and the nature of the work carried out. However, regardless of the size, every laboratory worker should be imparted at least a basic training on safety with regard to health and safety hazards of chemicals, and the hazards which may occur from the equipment and techniques one is likely to employ.

5.2 No employee or laboratory worker shall commence work involving highly dangerous materials or processes without first acquainting himself with the appropriate safety practices.

5.3 Emergency Response

5.3.1 *Emergency Planning*

5.3.1.1 During the course of normal laboratory operations there is always the potential for an emergency situation to arise. These emergencies can be a result of chemical spill and exposure, or fire. Each and every laboratory should develop written emergency response plan based on nature of chemicals handled. Emergency response plan should be clearly defined and posted in a prominent place. It is essential that all employees should know how to act and react during the emergency. Periodic appraisal of the circumstances, which can lead to emergency situation, will reveal many avoidable problems.

5.3.1.2 *Major/emergency spills*

A chemical spill is classified as a major spill whenever it causes personal injury or chemical exposure that requires medical attention, causes a fire hazard or uncontrollable volatility; requires a need for breathing apparatus of the supplied air or self-contained type to handle the material involved; contaminates a public area; causes airborne contamination that requires local or building evacuation; causes a spill that cannot be controlled or isolated by laboratory personnel; cannot be properly handled due to lack of local trained personnel and/or equipment to perform a safe, effective cleanup; requires prolonged or overnight cleanup; involves an unknown substance; or enters the land or water.

The following general procedures should be used for all major/emergency spills:

a) If the spill presents an immediate danger, leave the spill site and warn others, control entry to the spill site, and wait for safety officer.

b) Attend to any persons who may have been contaminated. Remove contaminated clothing. Flush skin/eyes with water at least for 15 min to 30 min; use soap for intermediate and final cleaning of skin areas.

c) Protect yourself, and then remove injured person(s) to fresh air, if safe to do so.

d) Notify nearby persons and evacuate as necessary. Prevent entry, as necessary, by posting a guard in a safe area and/or shutting doors.

e) If flammable vapours are involved, do not operate electrical switches. Try to turn off or remove heat sources, where it is safe to do so.

f) If the substance involved is an unknown, then emergency spill response procedures are limited to self-protection, isolation of the chemical, and evacuating and securing the area involved.

g) Do not touch the spill without protective clothing.

h) Where the spill does not present immediate personal danger, try to control the spread or volume of the spill. It means shutting a door, moving nearby equipment to prevent further contamination, repositioning an overturned container or one that has a hole in the bottom or side, creating a dike by putting an absorbent around a spill.

j) Never assume gases or vapours do not exist or are harmless because of lack of smell.

k) Absorbents should be used to collect substances. Reduce vapour concentrations by covering the surface of a liquid spill with absorbent. Control enlargement of the spill area by diking with absorbent.

5.3.1.3 *Minor spill*

Minor spills are those spills, which do not fit the requirements for major spills. The following general procedures should be used for all minor spills:

a) Attend to any persons who may have been contaminated. If these persons require medical attention then it is an emergency spill.

b) Notify persons in the immediate area about the spill.

c) All non-essential personnel from the spill area should be evacuated.

d) If the spilled material is flammable, turn off ignition and heat sources.

e) Breathing vapours of the spilled material should be avoided. If respiratory protection is necessary this is an emergency spill.

f) Leave on or establish exhaust ventilation if it is safe to do so.

g) Secure supplies to effect cleanup.

5.3.2 *Emergency Alarm*

A fail-safe emergency alarm system, which is audible in all parts of the building, should be available in all chemical laboratories. The alarm system should be periodically tested for operational performance and audibility in the specified range.

5.4 Evacuation of Site

Apart from fire, other situations such as spilling of chemicals, leaking cylinders of toxic and corrosive gases also may require evacuation of personnel.

5.5 Reporting Systems

All accidents should be reported without delay to the laboratory supervisor or safety coordinator with all essential details to ensure prompt action.

5.6 Safety Awareness

5.6.1 A survey of industrial accidents has shown that a very large majority of accidents is due to human factors and can, therefore, be avoided. The two most important causes are ignorance of precautions to be taken and disregard of safety rules. For eliminating these causes, proper instructions are necessary; but written rules and regulations, and safety equipment by themselves are not enough to ensure safety in laboratory.

5.6.2 The first essential is to create an atmosphere of constant care and attention to even the smallest detail. This cannot come by itself but should be nurtured and developed by the person in-charge, who should set an example, and insist on its being followed by everybody else. Each newcomer should be trained to reach and then live up to the standard already set. In most laboratories, while care and accuracy are the primary considerations, speed is often of importance and there might be a tendency for even sufficiently trained staff to take chances. This should be discouraged at once, not only by the immediate associates of a newcomer but by those in charge of the laboratories.

5.6.3 In some schools or technical colleges, the students might have been imparted some rudiments in safe working. It will be useful to include in students' practical curriculum a course in 'Safety in chemical laboratories'. The students should be required to fit up different types of glass apparatus after the procedure had been demonstrated by a laboratory assistant. This also applies to the working of electric circuits and many other kinds of laboratory work.

5.7 Handling of Apparatus

5.7.1 *Glassware*

5.7.1.1 A laboratory worker should always be aware of the fact that glassware is likely to break, if handled roughly. Glass breakage is a common cause of injuries in laboratories. The importance of handling glass apparatus in the proper manner cannot be over-emphasized. While setting up an apparatus, it is necessary to ensure that all pieces are clamped and supported properly, different components may fall apart even with the smallest bumping and endanger both the experiment and the worker.

5.7.1.2 When cutting, tube or rod, make a simple cut at the point of fracture with a triangular file or a cutter. Place a cloth over the glassware to protect the hands. Then, hold the tube or rod with the thumbs together, opposite to the cut and, bend towards the body to get uniform and right angle break. To cut large-bore tubing, wound a piece of nichrome wire at the point of cut and heat it electrically.

5.7.1.3 All glass fractures should at once be fire polished in a Bunsen flame so as to round off the sharp corners, especially in case of glass tubing which is to be pushed through a rubber bung. When this is done, the size of hole in the bung should allow the glass to pass through with reasonable ease, after the glass has been lubricated with water or glycerine. The tube should be held in a cloth or leather gloves should be worn. The bung should not be held in such a way that the glass tube may be pushed into the hand holding the bung. The same care should be taken when withdrawing a glass tube or rod from a bung. If difficulty is met with, push a cork borer, of the size which will just pass over the tube into the bung, between the tube and the bung. Then withdraw the tube from inside the cork borer. If the tube is broken off short, it is better to scrap the bung.

5.7.1.4 Winchesters should be carried in suitable carriers made of wood provided with suitable handles. A cage should always be provided while using vacuum desiccators.

5.7.1.5 When glass containers have been used, they should be cleaned by the person who has used them. This ensures that other workers will not be endangered by small amounts of any harmful material remaining in the container. It is absolutely necessary that apparatus handed over for glass blowing has been cleaned thoroughly.

5.7.1.6 Test tubes should be held properly with test-tube holder while heating with the mouth pointing away from others and oneself, and should not be more than half full while being heated. Pipettes should not be left so that their ends protrude across the front edge of benches. While pipetting, always use pipette fillers (propipettes).

5.7.1.7 Wash-bottles or Winchester bottles made of colourless glass should not be left on benches where direct sunlight may fall, because they may act as lenses and focus sunlight on certain spots and cause fire. Such instances have been reported in literature. Also the windowsill area should be free of any apparatus/bottles.

5.7.1.8 The laboratory floor should be kept free of any glass apparatus or glass bottles containing chemicals.

5.7.2 *Electrical Apparatus*

5.7.2.1 Electrical apparatus, should be leak proof and properly earthed. New furnace packing may be damp and the furnace should be run for some hours at a moderate temperature until it is quite dry. The floor near electrical apparatus shall be dry and the workers shall not touch the apparatus with wet hands. Insulated wire should be used for all electrical connections. Electrical apparatus, which produce even the slightest shock, presents a potential danger and shall be disconnected and checked up immediately. Care should be taken to use only right kind of electric fuses. The fuse in use should be of appropriate current rating and lighter than the one installed by electrical staff in the mains wiring system. At no time the fuses of higher rating should be used. Charge accumulators in a separate room, not on a laboratory bench where a nearby spark or flame might cause the evolved gases to explode. With a glass accumulator such an accident can be quite harmful. Acid accumulators should be charged some distance away from the place where nickel iron accumulators, using an alkaline electrolyte, are charged. The mixing of the two electrolytes could have very serious consequences. All leads should be kept as short as possible. Electrical cables should never be allowed to come in contact with hot surface, which would burn the insulation, cause a short-circuit and create a fire hazard. No water points or rubber connections should be kept near the electrical plugs and switches; it is best to fix all electrical fittings at a small height over the bench, either against the wall or on the reagent rack so that accidental spillage of water on the bench cannot get to the electric connections.

5.7.2.2 An electric hair-drier should never be used to hasten the evaporation of an inflammable liquid, the coil can get over-heated and thus cause ignition of the vapours.

5.7.2.3 Electricity is dangerous and care should be taken while using it. The following literature reports death at 60 V ac:

a) All electrical equipment shall be properly grounded.

b) Extension chord shall not be used as a substitute for permanent wiring.

c) Electrical cords or other lines shall not be suspended unsupported across rooms or passageways. Cords should not be routed over metal objects such as emergency showers, overhead pipes or frames, metal racks, etc. Cords should not be ran through holes in walls or ceilings or through door ways or windows. Cords should not be placed under carpet, rugs or heavy objects. Cords should not be placed on pathways or other areas where repeated abuse can cause deterioration of insulation.

d) Multi-outlet plugs shall not be used unless they have a built-in circuit breaker. This causes overloading on electrical wiring, which will cause damage and possible overheating.

5.8 Working with Chemicals

5.8.1 Most of the chemicals could be regarded as hazardous and could be explosive, corrosive, flammable or a poison under certain circumstances.

5.8.2 Always use the safety appliances recommended while handling chemicals and avoid skin contact with chemical substances.

5.8.3 Chemicals should only be used when the drums, sacks, containers or pipelines containing them are clearly labelled and their identity confirmed. In case of doubt, or when a mix-up has actually occurred, inform supervisor immediately.

5.8.4 Avoid spillage of chemicals by careful handling. Keep suitable materials to chemically treat spillage, or physically containing if necessary.

5.8.5 Ensure that the clips/clamps are properly fixed while transferring chemicals through rubber, PVC or teflon hoses.

5.8.6 It is advisable to keep a water hose close by, whenever a chemical's transfer through drums, carboys, etc, is being performed (not in case of water sensitive chemicals).

5.8.7 Chemicals storage must always be done after considering their compatibility. Once a place for storing a particular chemical is fixed, it should not be altered without purpose.

5.8.8 Observe precautions concerning handling of chemicals as given in **3.2** and use safety equipment as given in **4.4**.

5.8.9 The containers of chemicals that are highly volatile or decompose or are moisture sensitive should be carefully opened and isolated from the surrounding.

5.8.10 Whenever chemicals are transferred from old containers to new containers, all relevant details should be transferred to labels on new containers.

5.8.11 Low temperature (cryogenic) liquids like liquid nitrogen, liquid oxygen, dry ice, etc, are also commonly used in laboratories. The hazards associated with the handling of cryogenic liquids are,

a) cold 'burns' to the person;

b) explosions due to the vapourization of liquefied gas into an enclosed space;

c) explosions due to chemical reaction or condensation of air;

d) asphyxiation due to exclusion of oxygen/air; and

e) oxygen enrichment of the surrounding atmosphere in case of liquid oxygen.

Always handle low temperature (cryogenic) liquids in well-ventilated areas to prevent excessive concentration of gas. Excessive amounts of liquid cryogens except liquid oxygen reduce the concentration of oxygen and can cause suffocation/ asphyxiation in a confined space. Portable oxygen detectors should be available with personnel associated with handling of cryogenic liquids. Personnel, including rescue workers, should not enter areas where oxygen concentration is below 19.5 percent, unless provided with self-contained breathing apparatus or airline respirator. No oil and grease shall be present on clothing or equipment when working with or around liquid cryogens specially liquid oxygen.

Skin contact with cryogenic liquids should be avoided as serious cold burns may occur. Care must be taken with gloves, wristbands or bracelets, which may trap liquid cryogen close to the skin. Do not carry liquid cryogens in an open Dewar on any elevator.

6 GENERAL LABORATORY TECHNIQUES

6.1 If it is necessary to continue an experiment overnight, leave precise and adequate information to night shift assistants or security staff.

6.2 Use proper equipment for experiments carried out under reduced or elevated pressure.

6.3 Vacuum flasks and desiccators should be regularly checked for signs of damage.

6.4 All experiments involving use of toxic chemicals should be carried out in a fume cupboard.

6.5 Use a cloth for protection when inserting glass

tubing, rods or thermometers into bungs or tubing. Use a lubricant, wherever necessary.

6.6 Compressed gas cylinders, when standing upright, should always be properly supported. Never connect a gas cylinder directly to the apparatus, always interpose a system of traps. Always turn off a gas cylinder at the main valve after use and release any excess pressure in the regulator.

6.7 It is to be ensured that condenser tubing does not become trapped. Make sure that all rubber connections to a condenser are well secured.

6.8 Highly volatile/inflammable chemicals should not be stored indefinitely inside refrigerator, unless suitably modified by removing the bulb and the thermostat outside the refrigerator cabinet. On no account must any food or drink be kept in laboratory refrigerators.

6.9 Labels on reagent bottles should not be altered or tampered with.

6.10 Nitrogen should be preferred to air on all capillary bleeds as a large number of organic substances oxidize at high temperatures.

6.11 Use proper stirring system after taking the volume of the flask into account.

7 SPECIFIC TECHNIQUES

7.1 Solvent Extraction and Solvent Stripping

If extraction is carried out in a separating funnel, release the pressure at frequent intervals by inverting the funnel with the stopper securely held and opening the top with care. Point the funnel away from the eyes and naked flames.

7.1.1 Always ensure that the condensing systems are adequate to cope with solvent use.

7.1.2 Chemicals like dialkyl ethers, tetrahydrofuran form peroxides in contact with air and sunlight. They should be stored in dark bottles.

7.1.3 Do not attempt to distil solvents nearly to dryness since these concentrates may contain explosive peroxides.

7.1.4 Naked flame should not be used for reactions involving inflammable solvents.

7.2 Vacuum Distillation

7.2.1 Distillation under reduced pressure should always be carried out behind adequate shields.

7.2.2 Always use a suitable trap between the sources of vaccum and the apparatus.

7.2.3 Evacuate the apparatus and check for leaks before commencing heating. Avoid heating by direct flame.

7.2.4 Never subject the apparatus to rapid changes of pressure; at the end of distillation, allow it to cool before slowly admitting air.

7.2.5 Do not use water-cooled condenser, if the distillate is entering the condenser above 160°C.

7.3 Organic Preparative Reactions

7.3.1 Special conditions must be complied with for experiments continued outside normal working hours; leave special instructions to the night shift assistants and security staff.

7.3.2 It should be ensured that the stirring gear is in good order before starting an experiment. Do not restart a stirrer, if it has been stopped for any length of time in a heated reaction flask; allow it to cool first.

7.3.3 Condenser capacity should be in excess of requirements. Always make provisions for rapid removal of the heating source.

7.3.4 In order to study the behaviour of new experiments, testing material quantity should be as minimum as possible in case of the following:

a) First time experiments;
b) Experiments with alkali metals, cyanides, etc;
c) Halogenations, alkylations;
d) Reactions involving fluorine, HF, BF3, etc;
e) Reactions involving alkylene oxides;
f) Polymerization reactions;
g) Nitric acid oxidants;
h) Reactions involving the use of H_2O_2; and
j) Exothermic reactions.

7.3.5 The bench should be kept dry in the vicinity of an experiment involving alkali metals. It should be ensured that pieces of the metal do not fall into water or oil baths during addition.

7.4 Pressure Reactions

Utmost care should be taken in carrying out sealed tube reactions. When the pressure is likely to develop, a sealed tube should never be filled up more than one-third of its volume. The initial runs should be done with very small quantities of reactants. Sealed tubes should be protected by a steel tube or a wire cage and the temperature should be raised gradually. These reactions should be carried out in a separate room behind a safety screen. Before opening the tube, it should be well-cooled in ice, tip is then blown off with a pointed flame and when the pressure

has been released, the tube may be cut. Autoclave and other pressure vessels should be set up in separate rooms and not in the general laboratory. The autoclaves should have safety valves in proper working conditions.

8 MEASURES IN CASE OF ACCIDENTS

8.1 General

8.1.1 Inspite of all precautions, accidents sometimes occur and it is then necessary to take immediate steps to help the injured persons, and to do everything possible to prevent further damage. Only those on the spot can take a decision as to which of these objectives is more important. If there is little risk or condition of the injured becoming serious, it might be necessary to send for a doctor, and to apply first-aid as the first job. In case of a hazardous situation, it may be advisable to summon fire-fighters and to warn others in the building.

8.1.2 Information regarding an accident should reach the supervisor/safety coordinator or any other authority as early as possible.

8.1.3 It is, of course, imperative that, at the earliest possible moment, all sources of danger shall be eliminated. If the trouble is electrical, switch off the mains. If a fire has broken out, turn off the gas at the main, and switch off the electric power so that, if insulation is burned off from wires, an electrical fire may not start. Remove the combustible materials in the laboratory or put them away from the source of danger. Leaking containers of poisonous gas or liquid should be removed to the open air after wearing self-contained breathing apparatus and area is to be cordoned off. Somebody should be posted to guard and to see that no one goes near them.

8.1.4 While every effort is being made to make the laboratory safe, it is equally important to bring all possible help to those who are injured. The doctor should be summoned at once, and pending his arrival, those who are trained in first-aid should give immediate treatment to those injured. In any case, remove the victims to fresh air and keep them warm and at rest. If there is a fire, or a risk of fire, they should be removed out of danger zone.

8.1.5 The actual treatment to be given would have to be decided upon by the persons carrying out first-aid, as there may be two or more kinds of injury, such as a cut or asphyxiation and a bruise. Some first-aid treatments for more common injuries are given in **8.3**.

8.1.6 As soon as the situation permits, the details of the accident should be entered in the accident book. It should not be overlooked that a full description including minor details about an accident might throw light on its causes and measures could be taken for prevention of such accidents in future.

8.2 Fire Safety

8.2.1 The rules involving smoking, electrical work, open flames, handling flammable material and static electricity should be strictly followed. Fire fighting equipment and emergency exits should be kept clean and ready for immediate use. Emergency siren should be in working condition.

8.2.2 Good housekeeping will do much to prevent fires. Proper disposal of waste material and clean up of spillage are essential. Flammable waste should be stored in glass or metal containers and not in paper or wooden barrels.

8.2.3 If a fire starts on the job, raise alarm and simultaneously use the fire extinguisher provided in the area to bring down a small blaze and try to extinguish fire before arrival of plant fire squad. A delayed alarm may cause the loss of precious minute and allow a fire to grow to such proportions that it may destroy the entire building, in spite of all efforts of organized fire fighting forces.

8.2.4 In the event, if a fire occurs and is extinguished without an alarm being sounded, immediately notify to the fire/security officer. This will enable them to inspect the area and replace any fire extinguisher that may have been emptied.

8.2.5 Unless a person is a member of the plant fire squad or belong to the laboratory, he should not go near fire; it will only cause obstruction and may endanger him and others.

8.2.6 Every person would be able to recognize the different types of fire and learn the right kind of extinguisher to use. The details of different classes of fires and types and number of fire extinguishers required for each area/section are given in IS 2190.

8.2.7 Each person may be required to be trained to use fire extinguisher and first-aid fire fighting measures. Speed is essential in fighting a fire. Most fires start small and can be confined, if acted promptly.

8.3 First-Aid

8.3.1 *First-Aid Facility*

8.3.1.1 First-aid must be provided in any chemical laboratory. However minor, an injury always must be attended to and first aid be given/taken. Incidents arising as a direct result of work performed are avoidable if one observes the principles of safe working conditions. Failure to observe safe working principles results in accidents. No matter how minor an incident, it will need proper examination and corrective measures to avoid recurrence of such incidence. Constant supervision and improvement

of working methods is the best defence against the occurrence of hazards.

8.3.1.2 Information regarding the location of first-aid and first-aider should be displayed in all places of work. All laboratories should maintain prescribed number of first-aid boxes containing copy of leaflet giving advice on first aid treatment. First-aid boxes should contain sufficient number of sterilized, unmedicated dressings of various sizes, adhesive wound dressings, plaster, sterilized absorbent cotton, eye pads, approved eye ointment and safety pins. In addition, eye wash bottles with clean water should be placed at strategic points.

8.3.2 *First-Aid Measures*

8.3.2.1 *Inhalation*

Remove victim from exposure and move to fresh air immediately. Remove contaminated clothing and loosen remaining clothing. Allow victim to assume most comfortable position and keep warm. Keep at rest until fully recover. If breathing is difficult, qualified personnel should administer oxygen. If not breathing, give artificial respiration. Do not use mouth-to-mouth resuscitation without knowing the chemicals inhaled by the victim. In case of HCN, gas only use the Silvester method. Do not give anything to drink or do not induce vomiting if person is unconscious. In event of cardiac arrest, apply external cardiac massage. Seek immediate medical assistance.

8.3.2.2 *Skin contact*

Move person away from contamination. Flush immediately with plenty of water for at least 15 min while removing contaminated clothing and shoes. If necessary, arrange for transport to hospital or to a doctor for medical attention. The information regarding the hazardous chemical along with details of first-aid given should accompany the casualty. Wash contaminated clothing before reuse.

8.3.2.2.1 *Eye contact*

Flush eyes thoroughly with water for at least 15 min. Hold the eyelids open and away from the eyeballs to ensure that all surfaces are flushed thoroughly. Call a physician, preferably an ophthalmologist, immediately or arrange for transport to hospital for immediate medical attention and treatment of eye injury. Information regarding the chemical that is material safety data sheet should accompany the patient.

8.3.2.3 *Ingestion*

Do not induce vomiting. Have victim rinse out mouth with water, and then drink sips of water to remove taste from mouth. Do not give liquids to a drowsy, convulsing or unconscious person. If vomiting occurs spontaneously, keep head below hips to prevent aspiration of liquid into the lungs. Seek medical attention immediately or arrange for transport to hospital for immediate medical attention and treatment. Information regarding the chemical swallowed, its concentration and quantity, material safety data sheet of the chemical should accompany the patient.

8.3.3 *Special Treatments*

8.3.3.1 *For hydrogen fluoride, hydrofluoric acid or related compounds*

These chemicals cause destructive and extremely painful burns on tissues when they come in contact. Immediate action should be taken, if splashed.

a) *Splashes in the eye* — Splashes of hydrogen fluoride or hydrofluoric acid in the eyes must be treated immediately by flooding for at least 15 min with large volumes of gently running water from a tap. The urgent removal of patient to hospital is essential since failure to treat correctly may result in loss of vision.

b) *Splashes on the skin* — All contaminated clothing should be removed and flood the skin with large volumes of running water. Thereafter 2 percent calcium gluconate gel should be applied liberally to the affected parts and massaged into the skin till medical aid is available. If nails have been penetrated by the acid the gel be liberally applied over and around the nail and the area, and massaged continuously for at least 15 min. All cases of hydrogen fluoride or hydrofluoric acid splashes must be referred to hospital after washing the skin and starting the above treatment with the ointment.

8.3.3.2 *For hydrogen cyanide*

Observe the following rules in case of hydrogen cyanide inhalation:

a) Care should be taken so that rescuer does not fall a victim to the same gas.

b) If conscious and breathing, remove the patient immediately to the hospital.

c) If breathing stops, place the casualty in the prone position with the mouth down with a clear breathing passage. Give artificial respiration by the Silvester method. Do not use the mouth-to-mouth method because the first-aider may inhale the hydrogen cyanide gas himself. Artificial respiration should be given by a trained first-aider.

8.3.4 *Electric Shock*

Power supply should be isolated. If the victim is unconscious or has stopped breathing, begin artificial respiration without delay. The patient is to be shifted to hospital for treatment of,

a) *Unconsciousness* — Always victims should be placed on their sides to prevent suffocation.

b) *Broken bones, dislocations* — Keep the victim still. Do not manipulate the injury.

c) *Shock, heart attack* — If the face is white, place upper part of the body in low position. If the face is red, place upper part of the body in a high position.

d) *Convulsions/fits* — Patient should be laid down carefully, protecting his head with a pillow or clothing.

8.4 Material Safety Data Sheets

8.4.1 Material safety data sheets should be prepared for all chemicals handled in laboratory as per the format given in Annex B. Copies of it should be placed at all locations where they are used and handled.

8.4.2 *Labelling Hazardous Chemical Containers*

All chemicals should be labelled according to standard practice and placed at their earmarked locations. In their labelling, various safety points should be included like nature of chemical that is fire/explosion hazards and index, corrosive, flammable, toxic, flash point etc, as per material safety data sheet.

ANNEX A

[*Clauses* 4.2 *and* 4.3 (c)]

INCOMPATIBLE CHEMICALS

A-1 LIST OF INCOMPATIBLE CHEMICALS

Chemical	*Incompatible with*
Acetic acid	Chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides, permanganates
Acetone	Concentrated nitric and sulphuric acid mixtures
Acetylene	Chlorine, bromine, copper, fluorine, silver, mercury
Alkali and alkaline earth metals (such as powdered aluminum or magnesium, calcium, lithium, sodium, potassium)	Water, carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide, halogens
Ammonia (anhydrous)	Mercury (for example, in manometers), chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric acid (anhydrous)
Ammonium nitrate	Acids, powdered metals, flammable liquids, chlorates, nitrates, sulphur, finely divided organic combustible materials
Aniline	Nitric acid, hydrogen peroxide
Arsenical compounds	Any reducing agent
Azides	Acids
Bromine	See chlorine
Calcium oxide	Water
Carbon (activated)	Calcium hypochlorite, all oxidizing agents
Carbon tetrachloride	Sodium
Chlorates	Ammonium salts, acids, powdered metals, sulphur, finely divided organic or combustible materials
Chromic acid and chromium trioxide	Acetic acid, naphthalene, camphor, glycerol, alcohol, flammable liquids in general
Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gases), hydrogen, sodium carbide, benzene, finely divided metals, turpentine
Chlorine dioxide	Ammonia, methane, phosphine, hydrogen sulphide
Copper	Acetylene, hydrogen peroxide

Chemical	*Incompatible with*
Cumene hydroperoxide	Acids (organic or inorganic)
Cyanides	Acids
Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens
Fluorine	All other chemicals
Hydrocarbons (such as butane, propane, benzene)	Fluorine, chlorine, bromine, chromic acid, sodium peroxide
Hydrocyanic acid	Nitric acid, alkali
Hydrofluoric acid (anhydrous)	Ammonia (aqueous or anhydrous)
Hydrogen sulphide	Fuming nitric acid, oxidizing gases
Hypochlorites	Acids, activated carbon
Iodine	Acetylene, ammonia (aqueous or anhydrous), hydrogen
Mercury	Acetylene, fulminic acid, ammonia
Nitrates	Acids
Nitric acid (concentrated)	Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulphide, flammable liquids and gases, copper, brass, any heavy metals
Nitrites	Acids
Nitroparaffins	Inorganic bases, amines
Oxalic acid	Silver, mercury
Oxygen	Oils, grease, hydrogen, flammable liquids, solids, or gases
Perchloric acid	Acetic anhydride bismuth and its alloys, alcohol, paper, wood, grease, oils
Peroxides, organic	Acids (organic or mineral), avoid friction, store cold
Phosphorous (white)	Air, oxygen, alkalis, reducing agents
Potassium	Carbon tetrachloride, carbon dioxide, water
Potassium chlorate	Sulphuric and other acids
Potassium perchlorate (*see also* chlorates)	Sulphuric and other acids
Potassium permanganate	Glycerol, ethylene glycol, benzaldehyde, sulphuric acid
Selenides	Reducing agents
Silver	Acetylene, oxalic acid, tartaric acid, ammonium compounds, fulminic acid
Sodium	Carbon tetrachloride, carbon dioxide, water
Sodium nitrite	Ammonium nitrate and other ammonium salts
Sodium peroxide	Ethyl or methyl alcohol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerin, ethylene glycol, ethyl acetate, methyl acetate, furfural
Sulphides	Acids
Sulfuric acid	Potassium chlorate, potassium perchlorate, potassium permanganate (similar compounds of light metals, such as sodium, lithium)
Tellurides	Reducing agents

NOTE — The following list is not a complete list of incompatibles; this has to be used only as a guide.

ANNEX B

(*Clause* 8.4.1)

MATERIAL SAFETY DATA SHEET FORMAT

B-1 MATERIAL SAFETY DATA SHEET FORMAT

Identity (As Used on Label and List) and Maximum Quantity handled at any time.

1.	**Chemical Identity**			
	Chemical Name	Chemical Classification		
	Synonyms	Trade Name		
	Formula	CAS No.	U.N. No.	
	Regulated Identification	Shipping Name Codes/Label	Hazchem No:	
		Hazardous Waste I.D. No:		
	Hazardous Ingredients	CAS No.	Hazardous Ingredients	CAS No.
	1.		3.	
	2.		4.	
2.	**Physical and Chemical Data**			
	Boiling Range/Point °C	Physical State	Appearance	
	Melting/Freezing Point °C	Vapour Pressure @35°C mm Hg	Odour	
	Vapour Density (Air=1)	Solubility in water @30°C	Others	
	Specific Gravity Water = 1	*p*H		
3.	**Fire and Explosion Hazard Data**			
	Flammability Yes/No	LEL %	Flash Point °C	Autoignition Temperature °C
	TDG Flammability	UEL %	Flash Point °C	
	Explosion Sensitivity to Impact	Explosion Sensitivity to Static Electricity	Hazardous Combustion Products	
	Hazardous Polymerization			
	Combustible Liquid	Explosive Material	Corrosive Material	
	Flammable Material	Oxidiser	Others	
	Pyrophoric Material	Organic Peroxide		
4.	**Reactivity Data**			
	Chemical Stability			
	Incompatibility with other material			
	Reactivity			
	Hazardous Reaction Products			

NOTE — Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.

5.	**Health Hazard Data**	
	Routes of entry	
	Effects of Exposure/ symptoms	
	Emergency treatment	
	TLV (ACGIH) ppm mg/m^3 **STEL** ppm mg/m^3	
	Permissible Exposure Limit ppm mg/m^3 Odour Threshold ppm mg/m^3 LD_{50} LD_{50}	
	NEPA Hazard Health Flammability Stability Special Signals	
6.	**PREVENTIVE MEASURES**	
	Personnel Protective Equipment Handling and Storage Precautions	
7.	**Emergency and First-Aid Measure**	
	Fire Fire Estinguising Media	
	Fire	Special procedures
		Unusual hazards
	Exposure	First-Aid Measures
		Antidotes/Dosages
	Spills	Steps to be taken
		Waste Disposal Method
8.	**Additional Information/References**	
9.	**Manufacturer/Suppliers Data**	
	Name of Firm Mailing Address Telephone/Telex Nos. Telegraphic Address	Contact person in emergency
		Local bodies involved
		Standard packing
		Tremcard Details/Ref
		Other
10.	**Disclaimer**	
	Information contained in this material safety data sheet is believed to be reliable but no representation guarantee of warranties of any kind are made as to its accuracy, suitability for a particular application or results to be obtained from them. It is upto the manufacturer/seller to censure that the information contained in the material safety data sheet is relevant to the product manufactures/ handled or sold by him as the case may be. The government makes no warranties expressed or implied in respect of the adequacy of this document for any particular purpose.	

ANNEX C
(*Foreword*)

COMMITTEE COMPOSITION

Occupational Safety and Health and Chemical Hazards Sectional Committee, CHD 8

Organization	*Representative(s)*
National Safety Council, Navi Mumbai	SHRI K. C. GUPTA ***(Chairman)***
Airport Authority of India, New Delhi	SHRI A. N. KHERA SHRI M. DURAIRAJAN (*Alternate*)
Alkali Manufacturers' Association of India, New Delhi	DR Y. R. SINGH
Atomic Energy Regulatory Board, Mumbai	SHRI R. BHATTACHARYA
Bhabha Atomic Research Centre, Mumbai	SHRI S. SOUNDARARAJAN SHRI S. D. BHARAMBE (*Alternate*)
Central Boiler Board, New Delhi	REPRESENTATIVE
Central Leather Research Institute, Chennai	SHRI G. SWAMINATHAN
Central Mining Research Institute, Dhanbad	SHRI J. K. PANDEY
Central Warehousing Corporation, New Delhi	SHRI F. C. CHADDA SHRI S. C. GUPTA (*Alternate*)
Century Rayon, Thane	SHRI H. G. UTTAMCHANDANI SHRI S. K. MISHRA (*Alternate*)
Confederation of Indian Industries, New Delhi	SHRI A. K. GHOSE SHRI SHIKHAR JAIN (*Alternate*)
Consumer Education & Research Centre, Ahmedabad	DR C. J. SHISHOO SHRI S. YELLORE (*Alternate*)
Department of Space (ISRO), Sriharikota	SHRI SHYAMAL KUMAR KANUNGO SHRI V. K. SRIVASTAVA (*Alternate*)
Department of Industrial Policy and Promotion, New Delhi	DR D. R. CHAWLA
Directorate General Factory Advice Service & Labour Institute, Mumbai	SHRI S. S. GAUTAM SHRI SUSHIL KUMAR (*Alternate*)
Directorate General of Health Services, New Delhi	DR P. H. ANATHANARAYANAN DR A. N. SINHA (*Alternate*)
Directorate General of Mines Safety, Dhanbad	DIRECTOR OF MINES (MSE) DEPUTY DIRECTOR OF MINES SAFETY (HQ) (*Alternate*)
Directorate of Industrial Safety and Health, Mumbai	SHRI S. D. JAGTAP
Directorate of Standardization, Ministry of Defence, New Delhi	SHRI P. S. AHUJA LT-COL TEJINDER SINGH (*Alternate*)
Employees State Insurance Corporation, New Delhi	DR A. M. PATIL DR G. N. BANKAPUR (*Alternate*)
Hindustan Aeronautics Ltd, Bangalore	SHRI S. V. SURESH
Hindustan Lever Ltd, Mumbai	SHRI B. B. DAVE SHRI ADITYA JHAVAR (*Alternate*)
Indian Association of Occupational Health, Bangalore	REPRESENTATIVE
Indian Chemical Council, Mumbai	SHRI PRAKASH WAGLE SHRI A. A. PANJWANI (*Alternate*)

Organization	*Representative(s)*
Indian Institute of Chemical Technology, Hyderabad	SHRI RAJESHWAR RAO
Indian Institute of Safety and Environment, Chennai	DR M. RAJENDRAN DR G. VENKATARATHNAM (*Alternate*)
Indian Institute of Toxicology Research, Lucknow	DR VIRENDRA MISHRA DR V. P. SHARMA (*Alternate*)
Indian School of Mines, Dhanbad	PROF D. C. PANIGRAHI
Ministry of Defence (DGQA), New Delhi	SHRI M. S. SULTANIA SHRI SUJIT GHOSH (*Alternate*)
Ministry of Defence (R&D), Kanpur	DR A. K. SAXENA DR RAJINDRA SINGH (*Alternate*)
Ministry of Environment & Forest, New Delhi	REPRESENTATIVE
Ministry of Home Affairs, New Delhi	SHRI OM PRAKASH SHRI D. K. SHAMI (*Alternate*)
National Institute of Occupational Health, Ahmedabad	DR H. R. RAJMOHAN DR A. K. MUKHERJEE (*Alternate*)
National Safety Council, Navi Mumbai	SHRI P. M. RAO SHRI D. BISWAS (*Alternate*)
NOCIL, Mumbai	DR B. V. BAPAT SHRI V. R. NARLA (*Alternate*)
Office of the Development Commissioner (MSME), New Delhi	SHRI MATHURA PRASAD SHRIMATI SUNITA KUMAR (*Alternate*)
Oil Industry Safety Directorate (Ministry of Petroleum & Natural Gas), Delhi	SHRI SHASHI VARDHAN SHRI S. C. GUPTA (*Alternate*)
Ordnance Factory Board, Kolkata	SHRI V. RAMANAN DR S. P. SAXENA (*Alternate*)
Petroleum & Explosives Safety Organization, Nagpur	JOINT CHIEF CONTROLLER OF EXPLOSIVES
Reliance Industries Limited, Mumbai	DR P. R.TIPNIS
Safety Appliances Manufacturers Association, Mumbai	SHRI M. KANT SHRI KIRIT MARU (*Alternate*)
SIEL Chemical Complex, New Delhi	SHRI N. S. BIRDIE SHRI RABINDRA NATH SAHU (*Alternate*)
Southern Petrochemical Industries Corporation Ltd, Chennai	SHRI V. JAYARAMAN SHRI S. MURUGANANDAM (*Alternate*)
Steel Authority of India Ltd, Ranchi	SHRI V. K. JAIN
Tata AIG Risk Management Services Ltd, Mumbai	SHRI URMISH D. SHAH
Tata Chemicals Ltd, Mithapur	SHRI SANJIV LAL SHRI B. K. DEBATA (*Alternate*)
BIS Directorate General	SHRI E. DEVENDAR, Scientist 'F' and Head (CHD) [Representing Director General (*Ex-officio*)]

Member Secretary

SHRI N. K. PAL
Scientist 'E' (CHD), BIS

Organization	*Representative(s)*
Atomic Energy Regulatory Board, Mumbai	SHRI R. BHATTACHARYA **(*Convener*)** SHRI K. RAMPRASAD (*Alternate*)
Alkali Manufacturers' Association of India, New Delhi	DR Y. R. SINGH
Bhabha Atomic Research Centre, Mumbai	SHRI S. SOUNDARARAJAN SHRI A. P. SATHE (*Alternate*)
Central Food Technological Research Institute, Mysore	DR M. N. MANJUNATH SHRI ARUN KUMAR (*Alternate*)
Century Rayon, Thane	SHRI H. G. UTTAMCHANDANI SHRI S. K. MISHRA (*Alternate*)
Crop Care Federation of India, New Delhi	DR P. S. RAMANATHAN SHRI D. K. ARORA (*Alternate*)
Directorate General Factory Advice Service & Labour Institute, Mumbai	SHRI R. K. ELANGOVAN DR E. LAXMINARAYANA (*Alternate*)
Excel Industries Limited, Mumbai	SHRI VIPIN B. DOSHI SHRI DHANANJAY V. JOSHI (*Alternate*)
Gulf Oil Corporation Ltd, Hyderabad	SHRI Y. KRISHNA KUMAR
Hindustan Organic Chemicals Limited, Raigad	DR S. T. LONKAR SHRI S. N. BAILWAR (*Alternate*)
Indian Chemical Council, Mumbai	SHRI B. S. PUNIA SHRI P. N. PARMESHWAR MOOTHATHU (*Alternate*)
Indian Institute of Chemical Technology, Hyderabad	SHRI K.V. RAMANAYYA
Indian Institute of Petroleum, Dehradun	DR M. P. SAXENA SHRI G. S. DANG (*Alternate*)
Indian Institute of Toxicology Research, Lucknow	DR. VIRENDRA MISRA DR JAI RAJ BEHARI (*Alternate*)
Indian Petrochemical Corporation Ltd., Vadodora	SHRI P. VIJAIRAGHAVAN
Indian Space Research Institute, Bangalore	SHRI SHYAMAL KUMAR KANUNGO SHRI V. K. SRIVASTAVA (*Alternate*)
Ministry of Defence (DGQA), New Delhi	SHRI A. K. SINHA SHRI R. S. DIWAKAR (*Alternate*)
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National Institute of Occupational Health, Ahmedabad	DR. H. R. RAJMOHAN DR. A. K. MUKHERJEE (*Alternate*)
National Safety Council, Navi Mumbai	SHRI V. B. PATIL
Petroleum & Explosives Safety Organization, Nagpur	JOINT CHIEF CONTROLLER OF EXPLOSIVE
Ranbaxy Laboratories Limited, New Delhi	SHRI RAVINDRA KAMATH
Reliance Industries Limited, Mumbai	SHRI N. K. VALECHA SHRI S. G. PATEL (*Alternate*)
Shriram Institute for Industrial Research, Delhi	REPRESENTATIVE
Southern Petrochemical Industries Corporation Ltd, Chennai	SHRI S. MURUGANANDAM SHRI M. PARTHIBAN (*Alternate*)

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Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards: Monthly Additions'.

This Indian Standard has been developed from Doc No.: CHD 8 (1669).

Amendments Issued Since Publication

Amendment No.	Date of Issue	Text Affected

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Published by BIS, New Delhi